HOUSE OF COMMONS SESSION 2000–2001

SCIENCE AND TECHNOLOGY COMMITTEE

Sixth Report

ARE WE REALISING OUR POTENTIAL?

Volume I

Report and Proceedings of the Committee

Ordered by The House of Commons *to be printed*
28 March 2001

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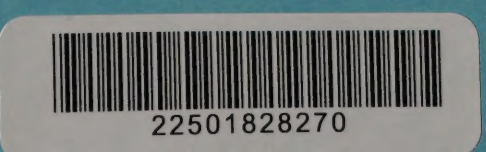

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The Science and Technology Committee is appointed to examine on behalf of the House of Commons the expenditure, administration and policy of the Office of Science and Technology (and any associated public bodies). Its constitution and powers are set out in House of Commons Standing Order No. 152.

The Committee has a maximum of eleven members, of whom the quorum for any formal proceedings is three. The members of the Committee are appointed by the House and unless discharged remain on the Committee until the next dissolution of Parliament. The present membership of the Committee is as follows:[1]

Dr Michael Clark MP (*Conservative, Rayleigh*)[2]
Sir Paddy Ashdown MP (*Lib Dem, Yeovil*)[6]
Dr Ian Gibson MP (*Labour, Norwich North*)[2]
Dr Brian Iddon MP (*Labour, Bolton South East*)[5]
Mr Robert Jackson MP (*Conservative, Wantage*)[3]
Dr Lynne Jones MP (*Labour, Birmingham Selly Oak*)[2]
Dr Ashok Kumar MP (*Labour, Middlesborough South and East Cleveland*)[2]
Mr Tony McWalter MP (*Labour, Hemel Hempstead*)[7]
Mr Ian Taylor MP (*Conservative, Esher and Walton*)[4]
Dr Desmond Turner MP (*Labour, Brighton Kemptown*)[2]
Dr Alan W Williams MP (*Labour, Carmarthen East and Dinefwr*)[2]

On 30 July 1997, the Committee elected Dr Michael Clark as its Chairman.

The Committee has the power to require the submission of written evidence and documents, to examine witnesses, and to make Reports to the House. In the footnotes to this Report, references to oral evidence are indicated by 'Q' followed by the question number, references to the written evidence are indicated by 'Evidence' followed by a page number.

The Committee may meet at any time (except when Parliament is prorogued or dissolved) and at any place within the United Kingdom. The Committee may meet concurrently with other committees or sub-committees established under Standing Order No. 152 for the purposes of deliberating, taking evidence or considering draft reports. The Committee may meet concurrently with the House's European Scrutiny Committee (or any of its sub-committees) or the Environmental Audit Committee for the purposes of deliberating or taking evidence. The Committee may exchange documents and evidence with any of these committees, as well as with the House's Public Accounts and Deregulation Committees.

The Reports and evidence of the Committee are published by The Stationery Office by Order of the House. All publications of the Committee (including press notices) are on the Internet at www.parliament.uk/commons/selcom/s&thome.htm. A list of Reports of the Committee in the present Parliament is at the end of this volume.

All correspondence should be addressed to The Clerk of the Science and Technology Committee, Committee Office, 7 Millbank, London SW1P 3JA. The telephone number for general inquiries is: 020 7219 2794; the Committee's e-mail address is: scitechcom@parliament.uk.

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[1] Mrs Caroline Spelman MP (*Conservative, Meriden*) was appointed on 14 July 1997 and discharged on 22 June 1998.
Mr David Atkinson MP (*Conservative, Bournemouth*) was appointed on 14 July 1997 and discharged on 30 November 1998.
Mrs Jacqui Lait MP (*Conservative, Beckenham*) was appointed on 22 June 1998 and discharged on 5 July 1999.
Mr Nigel Beard MP *(Labour, Bexleyheath and Crayford*) was appointed on 14 July 1997 and discharged on 20 March 2000.
Mr Nigel Jones(*Liberal Democrat, Cheltenham*) was appointed on 14 July 1997 and discharged on 15 May 2000.
Mrs Claire Curtis-Thomas (*Labour, Crosby*) was appointed on 14 July 1997 and discharged on 13 March 2001.

[2] Appointed on 14 July 1997.

[3] Appointed on 5 July 1999.

[4] Appointed on 30 November 1998.

[5] Appointed on 20 March 2000.

[6] Appointed on 15 May 2000.

[7] Appointed on 13 March 2001.

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LIST OF RECOMMENDATIONS AND CONCLUSIONS

1. **We recommend that Forward Look be published annually, and that it be published together with the statistical supplement. It is widely used by the science, engineering and technology community. (Paragraph 15)**

2. **We recommend that the next issue of Forward Look provide a clear statement of Government's overall strategy for science and technology and show explicitly how expenditure figures match policy objectives. We look forward to publication of the departmental strategies and trust that these will contain meaningful measures of Departments' science, engineering and technology performance. (Paragraph 16)**

3. **Government must actively promote Foresight to a broad range of industrial sectors, and in particular to SMEs. The learned societies, trade associations and the regional development agencies would provide useful focal points for this activity. (Paragraph 23)**

4. **We recommend that Government make further use of Foresight in developing a coherent science, engineering and technology policy within and between Departments. (Paragraph 24)**

5. **On balance, Foresight has fallen short of its aims. It has the potential to be a valuable exercise but to date it has been disappointing. The quality of the second round reports is said to be variable. We look forward to the outcome of the review of Foresight being undertaken by the Minister for Science. In our view, Foresight needs to be refocussed and revitalised. (Paragraph 25)**

6. **The creation of the post of the Director General of the Research Councils appears to have been very successful. We regret, however, that the DGRC has become less visible of late: the post would benefit from a higher profile. (Paragraph 27)**

7. **We see no need at present for an "Expert Advisory Group" to advise the DGRC. (Paragraph 28)**

8. **The re-organisation of the Research Councils has proved a success. (Paragraph 30)**

9. **We recommend that the Director General of the Research Councils monitor closely interdisciplinary areas which cross council boundaries. The Research Councils should exchange best practice, looking where appropriate to remove unnecessary variations in working methods. (Paragraph 31)**

10. **The Research Councils seem to have got the balance about right, treating wealth creation and quality of life as secondary criteria to scientific excellence. (Paragraph 32)**

11. **We welcome the proposed change to the status of the Council for the Central Laboratory of the Research Councils, to bring it under the joint ownership of the grant awarding Research Councils. (Paragraph 33)**

12. **We look forward with interest to the outcome of the quinquennial review of the Research Councils. (Paragraph 34)**

13. **We consider that further efforts should be made to disseminate the Council for Science and Technology's work more widely. (Paragraph 37)**

14. **The Government should give more prominence to the activities of the Council for Science and Technology and respond to its recommendations. (Paragraph 38)**

15. **Universities have improved their technology transfer capabilities and links with industry. (Paragraph 42)**

16. **We recommend that the Government encourage greater collaboration and joint working to develop best practice on technology transfer across universities and to enhance the commercial exploitation of research. (Paragraph 42)**

17. **In the longer term Government should look to rationalise the plethora of technology transfer schemes aiming to develop a simplified, flexible unbureaucratic approach. (Paragraph 43)**

18. **Ministers should resist the temptation to launch new schemes when it would be better to strengthen existing ones. (Paragraph 43)**

19. **We recommend that the Government develop an overarching strategy for technology transfer activities and publish a framework to be actively promoted to all interested parties. (Paragraph 44)**

20. **We recommend that Government promote secondment schemes more actively and consider expanding those already in existence. (Paragraph 45)**

21. **Universities must protect their intellectual property appropriately, in the long term interest of both the university and the UK as a whole. The funding regime may need to be changed to allow the universities to take a longer term perspective. (Paragraph 46)**

22. **The management of Intellectual Property is critical if the UK is to be competitive in the global knowledge driven economy. (Paragraph 47)**

23. **In the longer term Government should look to rationalise the network of innovation support schemes. (Paragraph 49)**

24. **We recommend that the Government publish a guide outlining the schemes available to SMEs and actively promote these schemes, for example through the Regional Development Agencies and trade associations. (Paragraph 49)**

25. **We welcome the Government's introduction of measures to support innovative small businesses. (Paragraph 50)**

26. **We welcome the fiscal measures introduced in the Budget to encourage research and development and recommend that uptake be carefully monitored. Government should also conduct a proactive campaign to promote innovation among those parts of industry which are not traditionally strong in R&D. (Paragraph 51)**

27. **There needs to be better dialogue between scientists and the public. (Paragraph 53)**

28. **We welcome the increasing use of the term "Science and Society" or, even better, "Science for Society", to describe activities to promote dialogue and mutual understanding between the scientific community and the public. (Paragraph 55)**

29. **We recommend that the Government work with the scientific community to build a new strategy for promoting science and technology, building upon the work already being done but reaching out to a broader range of participants and a wider audience. (Paragraph 56)**

30. **We regret the move towards generalist science courses, which we fear will dilute the knowledge base and result in inadequate preparation for higher education in the sciences. (Paragraph 57)**

31. **The quality of science teaching in schools has become a major concern. (Paragraph 58)**

32. **We note that the House of Lords Committee highlights the decline in the amount of practical work in its recent Report on Science in Schools, and recommends that continuing professional development for teachers should be specifically targeted at the problem of declining practical work. We wholeheartedly endorse these views. (Paragraph 58)**

33. **How to attract high quality science and technology graduates into teaching is a real problem, to which there is no ready answer. Nevertheless, it is a matter which has to be addressed as a matter of urgency. (Paragraph 59)**

34. **It is essential that the Government develop a clear strategy for improving the quality of science teaching in all schools, providing for both teachers and students to gain experience of science and technology in "the real world". (Paragraph 60)**

35. **The inconsistency in the PhD stipend paid by different Research Councils and by independent agencies is unfair and is likely to be distorting, given the current levels of post-doctoral research salaries. (Paragraph 65)**

36. **We welcome the very significant increase in the minimum PhD student stipend, but we believe that it is still not enough to ensure that the best graduates stay on to do doctoral research. The Government should work towards a further significant increase in the PhD student stipend. (Paragraph 66)**

37. **While the increase to the PhD stipend is welcome, a more serious problem lies with the pay and conditions for post-doctoral scientists. (Paragraph 67)**

38. **The Government can no longer afford to ignore the problem of low pay and poor job security for post-doctoral researchers and support staff. A shortage of skilled personnel threatens to undermine its commitment to strengthening the science base. (Paragraph 67)**

39. **What is important is to build on the strengths of the individual and to accord equal value, and rewards, to both teaching and research. (Paragraph 68)**

40. **We must do more to support excellent scientists and engineers. (Paragraph 69)**

41. **The Government must ensure that schemes to encourage experienced entrepreneurs from abroad to come to the UK are not undermined by tax disincentives. (Paragraph 70)**

42. **We welcome the Government's commitment to improving opportunities for women in science, engineering and technology. (Paragraph 74)**

43. **It is clear that there are still barriers to women realising their potential in science, engineering and technology. (Paragraph 74)**

44. **We stand by our view that the Office of Science and Technology should remain with the Department of Trade and Industry, and that the Minister for Science should be raised to Cabinet rank. (Paragraph 75)**

45. **We hope that the departmental science strategies, which are expected to be published in the Summer of 2001, will demonstrate that departments are committing additional funding to research and development. The publication of Forward Look 2001 also provides an opportunity for Government to show the impact of the 2000 Spending Review on overall government expenditure on R&D. (Paragraph 76)**

46. **If public confidence in science is to be restored, it is essential that Government Departments have sufficient well-qualified scientific staff in-house to advise on scientific matters and to ensure that Government is able to make full use of science and technology; and there must be mechanisms to ensure that their advice is taken into account by policymakers. (Paragraph 77)**

47. **Devolution must not be allowed to weaken the UK science base. The Government must ensure that the devolved administrations are fully involved in the development of science policy in order to avoid inconsistency of purpose in the different parts of the UK. (Paragraph 78)**

48. **We recommend that the Office of Science and Technology update its report measuring the quality of the UK Science Base on a regular basis. (Paragraph 79)**

49. **Sustained and substantial funding of the science base will be required to ensure that the UK can continue to 'punch above its weight'. (Paragraph 79)**

50. **We are yet to see hard evidence that the policies introduced by *Realising Our Potential* have had a significant impact on investment in science and innovation. (Paragraph 80)**

SIXTH REPORT

The Science and Technology Committee has agreed to the following Report:—

ARE WE REALISING OUR POTENTIAL?

Introduction

1. In April 1993, the Government published the White Paper '*Realising Our Potential: A Strategy for Science, Engineering and Technology*'.[1] *Realising Our Potential* set out the Government's policies and objectives for science, engineering and technology (SET) and the contribution that SET makes to the UK economy and quality of life. It was the first general review of SET policy and organisation since the Rothschild and the Dainton Reports of the early 1970s.[2] Following the 1992 General Election, the Government had also introduced some structural changes to improve Whitehall's handling of science and technology policy. The Chancellor of the Duchy of Lancaster was given specific responsibility for science and designated 'Cabinet Minister for Science'. The Office for Science and Technology (OST) was formed within the Office of Public Service and Science in the Cabinet Office, bringing together the science elements of the former Department of Education and Science and the Chief Scientist's Office from the Cabinet Office.

2. In April 2000, we decided that it would be appropriate to examine the impact of *Realising Our Potential*. Policies arising from the White Paper had been in place for several years and we felt that it was timely to assess their success. We also hoped that our inquiry might contribute to the development of the next Government White Paper, then expected in the Autumn of 2000. Our terms of reference were to:

"Examine the extent to which the measures and objectives outlined in the White Paper have been successfully delivered, their impact on the management and performance of science and technology, and whether the structures it specified are still appropriate."[3]

3. In response to our call for evidence we received 51 memoranda from a broad range of individuals and organisations.[4] We held five evidence sessions in May to July 2000: from Professor Sir William Stewart, former Chief Scientific Advisor to Government;[5] from the Committee of Vice Chancellors and Principals;[6] from the Rt Hon Lord Waldegrave of North Hill, former Chancellor of the Duchy of Lancaster;[7] from Sir John Cadogan, former Director General of the Research Councils and from Sir Robert May, Chief Scientific Adviser to the Government;[8] and from representatives of ICI, BT and Rolls Royce.[9]

4. During the course of our inquiry it became clear that the new White Paper was to be published in the Summer of 2000 rather than the Autumn. Instead of seeking to influence the content of the new White Paper, we decided to extend our inquiry to include assessment of it and the associated science budget. In July 2000, the Government released its Science and Innovation White Paper,'*Excellence and Opportunity: A Science and Innovation Policy for the 21st Century*'.[10] Also in July 2000, the Government published the outcome of the 2000

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[1] *Realising Our Potential: A Strategy for Science, Engineering and Technology*, May 1993, Cm 2250.
[2] *A Framework for Government Research and Development*, Cmnd 5046, July 1972 - The Government's Response to The Organisation and Management of Government Research and Development (the Rothschild report) and *The Future of the Research Council System* (the Dainton report), Cmnd 4814, November 1971.
[3] Press Release No. 25 of Session 1999-2000, 20 April 2000
[4] See Volume II, Evidence, pp 69-217. A memorandum from the OST is published in HC 466-iv, Session 1999-2000; a memorandum from CVCP is published in HC 466-ii; and memoranda from ICI, BT and Rolls Royce are published in HC 466-v.
[5] Minutes of Evidence, Wednesday 10 May 2000, HC 466-i Session 1999-2000.
[6] Minutes of Evidence, Wednesday 14 June 2000, HC 466-ii, Session 1999-2000.
[7] Minutes of Evidence, Monday 19 June 2000, HC 466-iii, Session 1999-2000.
[8] Minutes of Evidence, Monday 26 June 2000, HC 466-iv, Session 1999-2000.
[9] Minutes of Evidence, Monday 3 July 2000, HC 466-v, Session 1999-2000.
[10] *Excellence and Opportunity - A Science and Innovation Policy for the 21st Century*, Cm 4814, July 2000.

Comprehensive Spending Review.[11] The Spending Review 2000 announcement was followed, in November 2000, by publication of the Science Budget which allocated funding for the three year period 2001-02 and 2003-04.[12]

5. In November 2000, we issued a second call for evidence inviting comments on *Excellence and Opportunity* and the Science Budget. We received a further 34 memoranda.[13] We took oral evidence in October 2000 from Lord Sainsbury of Turville, Minister for Science and OST officials, on the Science Budget;[14] and in March 2001 from the Rt Hon Stephen Byers MP, Secretary of State for Trade and Industry.[15]

6. We are grateful to all those who contributed to our inquiry by submitting evidence. We are also most appreciative of the work of the two specialists advisers who have assisted us: Professor Derek Burke, formerly Vice-Chancellor of the University of East Anglia; and Professor Michael Elves, formerly Director of the Office of Scientific and Educational Affairs, Glaxo Wellcome plc. We take this opportunity to thank Professor Burke and Professor Elves for their invaluable service throughout this Parliament.

Realising Our Potential

7. *Realising Our Potential* was preceded by an extensive consultation exercise. It set out a series of reforms which the Government believed were necessary to build on the country's existing strengths in science, engineering and technology. Improving the nation's competitiveness and quality of life were pervasive themes throughout the White Paper. The main purposes of the White Paper were:

- to break down barriers which had prevented the acceptance and recognition of the importance of science, engineering and technology, and its exploitation, to the country's future;
- to harness the strength in science and engineering to the creation of wealth in the UK by bringing it into closer, more systematic, contact with those responsible for industrial and commercial decisions;
- to modify the missions and structures and management of the Research Councils and Government research establishments to meet better the global challenges now faced by the UK; and
- to develop greater understanding and appreciation of science, engineering and technology by the British public.[16]

8. The initiatives it introduced were:

- Forward Look – an annual publication to monitor the overall success of its strategy;
- Technology Foresight – a programme to improve interaction between the science base, industry and Government, and to identify key emerging technologies and opportunities;
- a Council for Science and Technology – (to replace the Advisory Council on Science and Technology) to ensure that the Government benefited from independent and expert advice when deciding its own research spending priorities;

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[11] *Spending Review 2000, New Public Spending Plans 2001-2004*, Cm 4807.
[12] *Science Budget 2001-01 to 2003-04.* DTI/OST November 2000, Available via www.dti.gov.uk .
[13] Volume II, Evidence, pp 218-295. A supplementary memorandum from OST is published in HC 274-i, Session 2000-01.
[14] Minutes of Evidence, Wednesday 25 October 2000, HC 898-i, Session 1999-2000.
[15] Minutes of Evidence, Wednesday 7 March 2001, HC 274-i, Session 2000-2001.
[16] Cm 2250, paragraph 1.16.

- creation of the post of Director General of the Research Councils and absorption of the Advisory Board for the Research Councils into OST;
- restructuring of the Research Councils and re-organisation of their management structure; and
- a new campaign to spread the understanding of science through schools and amongst the public.[17]

Excellence and Opportunity

9. *Excellence and Opportunity* was built on the foundations of *Realising our Potential*, though – rather surprisingly – made no reference to it. It identified three main objectives:

- to maintain and enhance the excellence of the science base;
- to extend opportunities for innovation; and
- to restore public confidence in science.

10. In pursuit of these three objectives, the White Paper outlined a number of new initiatives. These included:

- a new £1 billion programme in partnership with the Wellcome Trust to renew the infrastructure for science;
- an additional £250 million to boost research in three key areas: genomics, e-science and basic technology;
- an increase in the PhD stipend, over three years, to £9,000 a year;
- a £4 million fund, in partnership with the Royal Society and the Wolfson Foundation, to assist in the recruitment of up to 50 top researchers;
- a Higher Education Innovation Fund of £140 million over three years;
- a new Foresight fund, initially worth £15 million;
- Regional Innovation Funds of £50 million a year to enable Regional Development Agencies to support clusters, incubators and new networking arrangements;
- a Small Business Research Initiative;
- publication of science and innovation strategies for Government Departments;
- stronger guidelines from the Chief Science Adviser on how scientific advice should be used in drawing up Government policy; and
- a new code of practice for scientific advisory committees to Government.[18]

[17] Cm 2250, paragraph 1.18.
[18] Cm 4814, chapter 1, paragraphs 32, 35 and 37.

The Spending Review 2000 and the Science Budget

11. The results of the Spending Review 2000 were announced in July 2000.[19] It provided for an increase in £725 million in the science budget over the three years 2001-02 to 2003-4. The Spending Review announced a strengthening of UK science and engineering, with an average 5.4% real growth a year in spending:

- to allow £1 billion for new laboratories and equipment, in partnership with the Wellcome Trust;
- to step up research in key areas like the human genome; and
- to do more to turn scientific knowledge into jobs and wealth.[20]

The Science Budget allocations were published in November 2000 showing distribution of funds to the Research Councils, the Royal Society, and the Royal Academy of Engineering and a range of funding initiatives.[21]

The Enterprise, Skills and Innovation White Paper

12. In February 2001, the Government (the Department of Trade and Industry (DTI) and the Department for Education and Employment (DfEE)) published an Enterprise, Skills and Innovation White Paper Opportunity for all in a world of change.[22] This White Paper included a number of initiatives to promote innovation:

- £90 million to promote the commercial exploitation of research focussing on genomics, basic technologies and e-science;
- the Enterprise Scholarship Programme to attract the brightest and best young graduates from around the world, particularly in hi-tech subjects, to come to the UK to develop their careers and start new businesses; and
- a pilot scheme to encourage British entrepreneurs abroad to set up companies in the UK to pursue innovative business proposals.[23]

13. The DTI also published a second edition of UK Competitiveness Indicators.[24] Among other things, these showed that the UK:

- underperforms nearly all its major competitors in terms of patents
- has a relatively low level of novel innovators; and
- needs to improve commercial exploitation of university research.

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[19] Cm 4807, paragraphs 5.14-5.16, 34.1-34.5.
[20] Cm 4807, Chapter 34.
[21] *Science Budget 2001-01 to 2003-04.* DTI/OST November 2000, page 3.
[22] *Opportunity for all in a world of change*, A White Paper on Enterprise, Skills and Innovation, Cm 5052, February 2001.
[23] Cm 5052, paragraphs 4.12-4.26, 6.10-6.14.
[24] *UK Competitiveness Indicators*: Second Edition, DTI, February 2001.

Forward Look

14. *Realising Our Potential* announced that a clear and up-to-date statement of the Government's strategy for science and technology would be published each year as 'Forward Look' to inform the industrial and academic research communities.[25] Forward Look replaced the Government's 'Annual Review of Government Funded Research and Development', which had provided a comprehensive account of publicly funded research and development, explaining the purposes for which different Departments funded their programmes, and indicating current expenditure plans. Forward Look was to have a broader scope than the Annual Review in outlining:

- the portfolio of public funded work best suited to the broader scientific and technological needs of the UK; and
- the extent to which current individual departmental science and technology programmes are matched to that portfolio.[26]

15. Forward Look was published, along with a statistical supplement, in 1994, 1995 and 1996. In 1997 and 1998 the statistical tables were published alone. In 1999 Forward Look was published again followed two months later by the statistical tables 'SET statistics'. In 2000, the statistics were again published alone. In our Report into Government Expenditure on Research and Development, published in April 2000, we recommended that Forward Look should resume annual publication.[27] In its response the Government outlined that it intended to produce new Forward Looks on a cycle consistent with the timing of future spending reviews.[28] It is next to be published in the Summer of 2001. In our follow up Report we urged the Government to re-instate annual publication.[29] In response to that Report, the Government argued that it made sense to publish Forward Look in the year following a Spending Review (to date, every two years), in order that it could set out departmental spending plans over the period of the Review; and that there would be little justification in publishing a full Forward Look in the intervening years if there was nothing new to say.[30] We do not accept this argument. While Forward Look in the intervening years might not have new spending plans to present, it is – as we have said before – "an effective management tool to ensure progress monitoring against objectives and a means of communicating the Government's plans and progress to a wider audience".[31] The evidence we have received in the inquiry confirms that Forward Look is widely felt to be useful.[32] Once again **we recommend that Forward Look be published annually, and that it be published together with the statistical supplement. It is widely used by the science, engineering and technology community.**

16. In our Report on Government Expenditure on R&D, published in April 2000, we recommended that the Forward Look match SET and R&D expenditure figures more specifically to policy objectives and the achievements of departmental science strategies.[33] In its response, the Government stated that from 2001 it would introduce departmental science and innovation strategies and these would develop improved measures of SET output performance, linked to policy objectives.[34] (These are expected to be published in the Summer of 2001.) It is not clear to what extent these will be included in Forward Look. Evidence received in this inquiry suggests that Forward Look should show more clearly how the research priorities contribute to

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[25] Cm 2250, paragraph 1.18.
[26] Cm 2250, paragraph 2.36.
[27] Fifth Report, Session 1999-2000, *Government Expenditure on Research and Development: the Forward Look*, HC 196-I, paragraph 1.
[28] Seventh Report, Session 1999-2000, *Government Expenditure on Research and Development: the Forward Look - The Government's Reply*, HC 723, Appendix, recommendation (a).
[29] HC 723, paragraph 10.
[30] Third Special Report, Session 1999-2000, *Government's Response to the Seventh Report of the Science and Technology Committee on the Government's Expenditure on Research and Development: The Forward Look – The Government's Reply*, HC 981, paragraph 17.
[31] HC 723, paragraph 10.
[32] Evidence, p 75, paragraph 3; p 91, paragraph 2; p 190, paragraph 1; p 163.
[33] HC 196-I, paragraph 3.
[34] HC 723, Appendix, recommendation (b).

an overall strategy for science and technology.[35] **We recommend that the next issue of Forward Look provide a clear statement of Government's overall strategy for science and technology and show explicitly how expenditure figures match policy objectives. We look forward to publication of the departmental strategies and trust that these will contain meaningful measures of Departments' science, engineering and technology performance.**

Foresight

17. *Realising Our Potential* laid out the framework for Technology Foresight, a programme which aimed to achieve a 'cultural change' of better communication, interaction and mutual understanding between the scientific community and Government Departments.[36] It also aimed to act as a means for gaining early notice of key emerging technologies and to improve understanding of the trends and uncertainties involved in future technological developments.[37] It was broadly based on similar methods used in Japan, Germany and the US.[38]

18. Technology Foresight was overseen by a Steering Group, chaired by the Chief Scientific Adviser, and operated through 15 sector based panels covering areas such as manufacturing, healthcare and chemicals. It was initially launched in 1994. In 1995 the first set of reports were published, outlining visions and recommendations for action. The first round led to a range of collaborative research programmes including Foresight Challenge, which was incorporated into Foresight LINK in 1997. Both programmes aimed to stimulate collaborative projects between the science base and industry to address Foresight priorities.

19. Technology Foresight was re-launched as Foresight on 1st April 1999. The second round was intended to have a broader focus, be more inclusive and balance the previous emphasis on competitiveness with increased emphasis on improved quality of life in the context of sustainable development.[39] The second round has 10 sector panels and three thematic panels (Crime Prevention, the Ageing Population and Manufacturing 2020). The latter address broader social and /or economic issues which might drive wealth creation or affect quality of life in the future. The future of Foresight is currently being reviewed by the Minister for Science and the Chief Scientific Adviser.[40]

20. Foresight is considered to be of more use in some sectors than others. Witnesses suggest Foresight has had a "moderate" effect in the biomedical sciences and has been of "little benefit" in the life sciences.[41] On the other hand, it has been enthusiastically supported by the chemicals sector.[42]

21. Foresight appears to have had variable success in identifying emerging technologies and the associated threats and opportunities. The first round was thought to focus too much on existing horizons rather than beyond them.[43] Professor Wilson, of the Committee of Vice Chancellors and Principals (now Universities UK), believed that, with the speed of technological development, it was difficult for Foresight to stay ahead of the game. Mr Byers felt that the second round reports, published in December 2000, were "rather variable in their quality".[44]

22. Foresight appears to have had only limited success in bringing about better communication, interaction and mutual understanding between the science base, industry and Government Departments. Witnesses recognised that since 1993 there has been a 'culture

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[35] Evidence, p 98, paragraph 2.1; p 102, paragraph 8.
[36] Cm 2250, paragraph 1.18.
[37] Cm 2250, paragraph 2.27.
[38] HC 466-iii, Session 1999-2000, Q 106.
[39] HC 466-iv, Session 1999-2000, p 44, issue 11 OST.
[40] HC 274-i, Q 37.
[41] Evidence, p 148, paragraph 2.10; p 182, paragraph 2.
[42] Evidence, p 190, paragraph 2.
[43] Evidence, p 102, paragraph 11.
[44] HC 274-i, Q 37.

change' in academia.[45] The Foresight process has provided a networking opportunity, but the extent to which it has been responsible for driving the observed culture change is doubtful.[46] Other factors such as the diminishing availability of public funding for research, success of start-up companies, and the increasing pace of research are thought to have been more influential.[47]

23. Foresight has not been very effective in engaging industry, particularly the small to medium sized enterprise (SME) sector. Witnesses suggest that Foresight should be more inclusive, extending well beyond the 'usual club' of research intensive companies, if the full potential of the exercise is to be realised.[48] We raised the need for increased involvement of SMEs in Foresight in our report on Government funding of research and development, recommending the development of a strategy to promote greater involvement in the process by SMEs.[49] In response, the Government outlined the activities used to draw in SMEs and stated that it would continue to make Foresight more accessible to SMEs throughout the UK, by constant monitoring, evaluation and refinement of its strategy.[50] **Government must actively promote Foresight to a broad range of industrial sectors, and in particular to SMEs. The learned societies, trade associations and the regional development agencies would provide useful focal points for this activity.**

24. Witnesses suggested that Foresight influences the research and funding councils' priorities, though in some cases these organisations already had, or were developing, their own methods for determining future priorities when Foresight was introduced.[51] The lack of impact of Foresight on Government Departments was raised by a number of our witnesses.[52] In the Government's response to our 2000 Report on R&D expenditure, it said that more needed to be done to ensure the flow through of Foresight information and ideas into departmental decisions on R&D priorities.[53] **We recommend that Government make further use of Foresight in developing a coherent science, engineering and technology policy within and between Departments.**

25. **On balance, Foresight has fallen short of its aims. It has the potential to be a valuable exercise but to date it has been disappointing. The quality of the second round reports is said to be variable. We look forward to the outcome of the review of Foresight being undertaken by the Minister for Science. In our view, Foresight needs to be refocussed and revitalised.**

The Director General of the Research Councils

26. Prior to *Realising Our Potential*, responsibility for policy on the science budget lay with the Department for Education and Science, Science Branch, and the Advisory Board of the Research Councils (ABRC) Secretariat.[54] The 1993 White Paper created the new role of Director General of the Research Councils (DGRC) and the functions of the Advisory Board for the Research Councils were absorbed into the Office for Science and Technology.[55] The post of DGRC was created to enable the Chief Scientific Adviser to concentrate upon his responsibilities for transdepartmental science and technology issues across Government.[56] The DGRC is responsible for securing the successful and high-quality operation of the Research Councils and in advising the Departmental Minister (the Chancellor of the Duchy of Lancaster until 1995, and now the Secretary of State for Trade and Industry and the Minister for Science)

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45 Evidence, p 101, paragraph 3; p 91, paragraph 3; p 135, paragraph 1; p 113, paragraph 2.
46 Evidence, p 91, paragraph 3; p 102, paragraph 10; p 113, paragraph 2.
47 Evidence, p 113, paragraph 2.
48 Evidence, p 137, paragraph 5.
49 HC 196-I, paragraph 50.
50 HC 723, Appendix, recommendation (g).
51 Evidence, p 102, paragraph 10; p 147, paragraph 2.9; p 155, paragraph 8; p 175, paragraph 7.
52 Evidence, p 164; p 168, paragraph 8; p 190, paragraph 2.
53 HC 723, Appendix, recommendation (g).
54 HC 466-iv, p 44, issue 13.
55 Cm 2250, paragraph 1.18.
56 Cm 2250, paragraph 3.26.

on the allocation of the funds to the Research Councils, the Royal Society and the Royal Academy of Engineering.[57] The post was held by Sir John Cadogan until 1998. The current DGRC is Dr John Taylor.

27. The creation of the post of DGRC is widely considered to have been beneficial. A range of witnesses highlight the important role that the DGRC played in securing a favourable settlement for science in the 1997 Comprehensive Spending Review.[58] The DGRC provides a focal point for the Research Councils, and has responsibility to ensure their joint working and to review their boundaries. Witnesses suggest that the creation of the DGRC has led to improved cross council collaboration, but also to some competition.[59] **The creation of the post of the Director General of the Research Councils appears to have been very successful. We regret, however, that the DGRC has become less visible of late: the post would benefit from a higher profile.**

28. *Realising Our Potential* proposed that the DGRC should be assisted by a small standing group of independent experts, the "Expert Advisory Group" but this was never established. It seems that the then Minister saw a danger of reconstituting the ABRC, in parallel with having the DGRC; and both Sir John Cadogan and Dr John Taylor favoured having a range of bodies and institutions from which they could draw advice.[60] On the other hand, the Royal Society thought that an independent group of experts would assist the DGRC in developing a national strategy for science.[61] **We see no need at present for an "Expert Advisory Group" to advise the DGRC.**

Re-structuring of the Research Councils

29. *Realising Our Potential* proposed that the Research Councils be re-structured. The proposed re-structuring led from the recognition that the existing system had a number of outdated boundaries.[62] In addition, it was felt that there should be a separate 'big science' council – covering areas, such as astronomy, where resources are shared globally – in order to limit to one council the budgetary impact of currency fluctuations.[63] Only minor changes were made to the remits of the Economic and Social Research Council (ESRC), the Natural and Environmental Research Council (NERC) and the Medical Research Council (MRC). The functions of the Science and Engineering Research Council were divided amongst three new Research Councils: an Engineering and Physical Sciences Research Council (EPSRC), a Particle Physics and Astronomy Research Council (PPARC) and a Biotechnology and Biological Sciences Research Council (BBSRC), which also absorbed the functions of the Agricultural and Food Research Council.[64] The Research Councils were given reformulated mission statements which made explicit their commitment to wealth creation and quality of life. The customer base for each council was clearly defined. Their management structures were modified: each was to have a part time Chairman, drawn from the user community, and a full time Chief Executive.[65] The revised structure was introduced in 1994.

30. The OST considers that the new Research Council structure is optimal, bringing together curiosity driven research and mission orientated research.[66] The evidence we have received provides positive support for the changes made.[67] Concerns are raised that the structure may have a negative impact on 'blue skies' research but no evidence of this has been cited.[68] There

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[57] Cm 2250, paragraphs 3.26, 3.27.
[58] Evidence, p 85, paragraph 14; p 133, paragraph 11; p 158, paragraph 32.
[59] Evidence, p 157, paragraph 31.
[60] HC 466-iv, p 40, issue 3.
[61] Evidence, p 141.
[62] HC 466-iii, Q 112.
[63] HC 466-iv, Q 168.
[64] HC 466-iv, p 42, issue 8.
[65] Cm 2250, paragraph 1.18.
[66] HC 466-iv, p 42, issue 8.
[67] Evidence, p 85, paragraph 12; p 115, paragraphs 6-7; p 166; p 170, paragraph 22; p 192, paragraph 6; p 213.
[68] Evidence, p 72, paragraph 6; p 92, paragraph 15; p 182, paragraph 2.

is some criticism of the Research Councils for focussing on short term priorities set by Government at the expensive of more long term aims.[69] In broad terms **the re-organisation of the Research Councils has proved a success.**

31. Dividing the responsibility for funding between a number of Research Councils may create problems for interdisciplinary science which crosses council boundaries. Lord Waldegrave told us that they had considered a single funding agency for science but that this was thought to be too unwieldy and bureaucratic.[70] Sir John Cadogan thought that it was not realistic to have one Research Council and that in practice you would still need to put in scientific divisions.[71] Our witnesses report that a number of mechanisms have been constructed to ensure that cross council interdisciplinary science is not neglected, but that more needs to be done.[72] It is suggested that commonality of approach would improve effectiveness and sharing of best practice should be emphasised.[73] **We recommend that the Director General of the Research Councils monitor closely interdisciplinary areas which cross council boundaries. The Research Councils should exchange best practice, looking where appropriate to remove unnecessary variations in working methods.**

32. Some witnesses raised the explicit commitment to wealth creation and quality of life in the Research Councils' mission statements. This does not appear yet to have had a great impact.[74] **The Research Councils seem to have got the balance about right, treating wealth creation and quality of life as secondary criteria to scientific excellence.**

33. In 1995, the Daresbury and Rutherford Appleton Laboratories and a number of associated large facilities, which had originally been placed within the EPSRC, were made into a separate Research Council, the Council for the Central Laboratory of the Research Councils (CCLRC). This was chiefly undertaken to clarify the customer-contractor relationship between the CCLRC and its principal customers, the other councils.[75] Witnesses express concern about this arrangement.[76] The OST acknowledges that the 'ticketing system' used to manage access impacted on demand for the services.[77] The OST has recently conducted the first stage of a quinquennial review of CCRLC. This has concluded that it should be brought under joint ownership of the grant awarding Research Councils.[78] The second stage of the review will now examine how this might be implemented. **We welcome the proposed change to the status of the Council for the Central Laboratory of the Research Councils, to bring it under the joint ownership of the grant awarding Research Councils.**

34. In addition to the review of CCLRC, the OST is currently conducting quinquennial reviews of the six grant awarding Research Councils. This will include analysis of their role, organisation, form of governance, performance and efficiency. **We look forward with interest to the outcome of the quinquennial review of the Research Councils.**

The Council for Science and Technology

35. *Realising Our Potential* proposed the replacement of the Government's Advisory Council on Science and Technology (ACOST) by the Council for Science and Technology (CST).[79] The White Paper envisaged that the new Council would draw on the findings of the Foresight programme and help to ensure that the Government benefited from outside, independent advice when deciding its research spending priorities. It was also stated that information generated by

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69 HC 466-ii, Q 96; Evidence, p 92, paragraph 15.
70 HC 466-iii, Q 114.
71 HC 466-iv, Q 175.
72 Evidence, p 93, paragraph 17; p 138, paragraph 13.
73 Evidence, p 166; p 192, paragraph 6.
74 Evidence, p 85, paragraph 13; pp 125-126, paragraph 6; p 138, paragraph 13; p 157, paragraph 23.
75 HC 466-iv, p 40, issue 10.
76 Evidence, p 126, paragraph 6.
77 HC 466-iv, p 40, issue 10.
78 See www.dti.gov.uk/ost .
79 Cm 2250, paragraph 1.18.

the Council would normally be made openly available. The CST reports formally to the Prime Minister and since 1995 it has been nominally chaired by the Secretary of State for Trade and Industry.

36. In its first few years, the CST does not appear to have operated very effectively.[80] In March 1998, the Council was re-established with clearer, more comprehensive terms of reference, increased independent membership and commitments to publish an annual report, its advice and information about its work.[81] Despite these changes, we still received evidence that ACOST was more influential and active.[82]

37. In our Report on the implications of the Dearing Report in 1998, we recommended that the changes to the CST be widely disseminated so that the Council's work carried the confidence of the wider research community.[83] Although, since this time, the CST has launched a website which includes information about its membership, work and meetings, several of our witnesses were unaware of its activities.[84] Although we realise that its primary role is to advise Government, **we consider that further efforts should be made to disseminate the Council for Science and Technology's work more widely.**

38. Since its re-launch the CST has produced three substantive advisory reports: a Review of Science and Technology Activity Across Government, July 1999; Technology Matters, February 2000; and Science Teachers, February 2000. Our evidence suggests that these reports were highly regarded.[85] We examined the work of the CST– which is described by OST as the "Government's premier advisory body"– in our recent Report on the Scientific Advisory System.[86] In that Report we questioned the influence the CST's reports had on Government policy. The Government has published an implementation plan in response to the CST's S&T Review and an initial response to the Science Teachers Report.[87] Each of these responses took almost a year to produce and we still await a published response to the Technology Matters report. As we recommended in our Scientific Advisory System Report, **the Government should give more prominence to the activities of the Council for Science and Technology and respond to its recommendations.**[88]

Technology Transfer

39. At the time of *Realising Our Potential*, the Government had in place a number of activities for promoting the transfer of technology and knowledge between the science and engineering base and industry. These included:

- the LINK scheme – which supports pre-competitive research projects with 50% or more of the funding provided by industry;[89]
- the Teaching Company Scheme – which facilitates the transfer of knowledge from universities to industry though the employment of an Associate who works in collaboration with industry and academic staff;[90] and
- Co-operative Awards in Science and Engineering (CASE) studentships – where the student is funded in part by industry and also conducts some research there.

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80 HC 466-iv, Q 214.
81 HC 466-iv, p 45, issue 14.
82 HC 466-iii, Q 131. Also Evidence, p 125, paragraph 3.
83 First Report, Session 1997-98, *The Implications of the Dearing Report for the Structure and Funding of University Research*, HC 303-I, paragraph 110.
84 Evidence, p 92, paragraph 5; p 98, paragraph 2.3; p 102, paragraph 12; p 138, paragraph 11.
85 Evidence, p 75, paragraph 6; p 169, paragraph 21; p 125, paragraph 3.
86 Fourth Report, Session 2000-01, *The Scientific Advisory System*, HC 257, paragraph 14. See also paragraph 44.
87 See www.cst.gov.uk .
88 HC 257, paragraph 14.
89 Cm 2250, paragraph 3.35.
90 Cm 2250, paragraph 7.18.

40. Many of the policies outlined in *Realising Our Potential* were designed to encourage closer contact and exchange between the science and engineering base and industry. The Government undertook to develop its schemes for technology transfer "to re-emphasise the importance of the interchange of ideas, skills, know-how and knowledge".[91] A number of new technology transfer schemes were introduced, including:

- Faraday Partnerships – which bring together networks of organisations that share a common sector or technology interest to promote improved interactions between the UK science and engineering base and industry;

- the Higher Education Reach Out to Business and the Community Fund (HEROBC) – which provides incentive funding for institutions to build a sustainable and broadly based capability to respond to the needs of industry and the community;

- the Science Enterprise Challenge – which aims to raise awareness of the importance of business enterprise at all levels within universities and foster understanding and co-operation between academics and the business world to ensure the commercial exploitation of technological innovation; and

- the University Challenge – which contributes towards seedcorn funding for the development of new commercial initiatives.

41. *Excellence and Opportunity* built on these schemes, and included:

- the Higher Education Innovation Fund – (incorporating HEROBC) to increase universities' capability to work with industry, particularly small firms;

- Business Fellows – to lead their academic colleagues in working with industry; and

- a further round of University Challenge and additional Faraday Partnerships.[92]

42. Our evidence suggests that, since *Realising Our Potential*, **universities have improved their technology transfer capabilities and links with industry.**[93] There are some notable centres of expertise but the full benefit of technology transfer activities have yet to materialise across the board; indeed perhaps it is too early to see clear returns.[94] It is suggested that there are a number of barriers to effective technology transfer. In some universities technology transfer is not recognised as a high enough priority or is perceived to be against the institution's culture. There is a shortage of relevant expertise in some universities and little awareness of best practice.[95] It is suggested that some of these barriers could be overcome by stimulating greater collaboration and joint working between academic technology transfer units.[96] **We recommend that the Government encourage greater collaboration and joint working to develop best practice on technology transfer across universities and to enhance the commercial exploitation of research.**

43. Many of our witnesses have argued that the number of schemes to foster technology transfer is excessive, that they need rationalisation and the bureaucracy of the application processes is cumbersome.[97] **In the longer term Government should look to rationalise the plethora of technology transfer schemes aiming to develop a simplified, flexible unbureaucratic approach.** However, new schemes should be allowed to bed down: there is a long absorption period before people get to know of their existence. All too often a scheme

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91 Cm 2250, paragraph 1.18.
92 Cm 4814, chapter 1, paragraph 35.
93 HC 466-ii, p 12, paragraph 16. HC 466-v, page 53, paragraph 4. Evidence, p 206.
94 Evidence, p 191, paragraph 4. HC 466-ii, p 13, paragraph 17.
95 Evidence, p 206.
96 Evidence, p 118, paragraph 18.
97 Evidence, p 73, paragraph 4.3; p 115, paragraph 4; p 118, paragraph 18; p 192, paragraph 5.

is abolished or redesigned just as it is becoming well established. Mr Byers candidly admitted the tendency for Secretaries of State to announce bright new initiatives, and accepted that there was a need to simplify, and focus, the schemes available.[98] **Ministers should resist the temptation to launch new schemes when it would be better to strengthen existing ones.**

44. The Wellcome Trust suggests that a clear strategy or framework be developed which would set the variety of funding schemes in context.[99] This would also assist in comparative evaluation of technology transfer schemes and show where gaps exist. **We recommend that the Government develop an overarching strategy for technology transfer activities and publish a framework to be actively promoted to all interested parties.**

45. People are key in transferring knowledge between academia and industry and vice versa. A number of schemes exist to facilitate secondments, but it has been suggested that they are not well used.[100] One specific proposal is that there should be a route to transfer senior scientists between academia and SMEs, in the life sciences.[101] **We recommend that Government promote secondment schemes more actively and consider expanding those already in existence.**

46. Intellectual property (IP) is a major area of concern. On the one hand there is concern that academics lack appreciation of IP and, on the other, that higher education institutions focus too strongly on short term gain, seeing IP as an immediate third source of income.[102] In the US, by contrast, universities are said to perceive their work in technology transfer as primarily a contribution to the universities' public or civic role, though of course they are much better funded.[103] As we said in our January 2000 Report on innovation in engineering and the physical sciences,[104] **universities must protect their intellectual property appropriately, in the long term interest of both the university and the United Kingdom as a whole. The funding regime may need to be changed to allow the universities to take a longer term perspective.**

47. *Excellence and Opportunity* outlined a number of key measures to improve handling of IP. These include:

- changing the rules for Government funded research, so that research bodies own their own IPR;
- issuing new guidelines on incentives and risk-taking for staff in public sector research establishments; and
- a new fund (£10 million) for commercialising research done in the public sector.[105]

The introduction of these new initiatives is timely. The DTI's Competitiveness Indicators have shown that UK underperforms nearly all its major competitors in terms of patents and needs to improve commercial exploitation of university research.[106] **The management of Intellectual Property is critical if the UK is to be competitive in the global knowledge driven economy.**

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[98] HC 274-i, Q 17.
[99] Evidence, p 118, paragraph 18.
[100] HC 466-v, page 53, paragraph 4.
[101] Evidence, p 92, paragraph 13.
[102] Evidence, p 191, paragraph 4; p 206.
[103] Professor Alan Windle, Foundation for Science and Engineering (27 February 2001).
[104] Second Report, Session 1999-2000, *Engineering and Physical Sciences Based Innovation,* HC 195-I, paragraph 72.
[105] Cm 4814, chapter 3, paragraph 40.
[106] *UK Competitiveness Indicators*: Second Edition, DTI, February 2001, pp 56, 59.

Innovation Support Programmes

48. *Realising Our Potential* set out the Government's commitment to make it easier for small and medium-sized firms to access innovation support programmes. Such programmes include:

- Small Firms Merit Award for Research and Technology (SMART) – which aims to stimulate small businesses to develop and market new science and technology based products, and to encourage the formation of new businesses and encourage investment in highly innovative technology;
- LINK; and
- the Teaching Company Scheme.[107]

49. Our evidence suggests that, as with technology transfer, there are too many schemes and that these present a confusing picture to users.[108] SMEs do not have the resources to investigate what each scheme may be able to offer them. **In the longer term Government should look to rationalise the network of innovation support schemes.** But as with technology transfer, new and existing schemes should be given time to bed down. **We recommend that the Government publish a guide outlining the schemes available to SMEs and actively promote these schemes, for example through the Regional Development Agencies and trade associations.**

50. Schemes such as SMART are considered important sources of pre-product funds for start-up and small companies and our witnesses suggest they should be extended in scale and scope.[109] It was also suggested that Government consider best practice from abroad, and the US Small Business Research Innovation Program, which provides funds to support innovative research conducted by small businesses was cited.[110] *Excellence and Opportunity* announced that the Government would be adopting a similar scheme, the Small Business Research Initiative.[111] *Excellence and Opportunity* also introduced a new Regional Innovation Fund, which is to support the formation of clusters and incubators and new clubs of scientists, entrepreneurs, managers and financiers. **We welcome the Government's introduction of measures to support innovative small businesses.**

51. In our Report on Engineering and Physical Science Based Innovation, published in February 2000, we concluded that the UK was strong in terms of scientific production but weaker in terms of its application and exploitation.[112] In this inquiry, several witnesses have commented that, while universities are becoming better at supplying technology and innovation, the UK business base is still not taking this up.[113] It has been shown that business expenditure on R&D as a percentage of GDP dropped from 1.44% in 1988 to 1.19% in 1998.[114] Mr Byers suggested that this was due to the fact that R&D was a long term investment and many UK companies still took a short-term approach.[115] In the March 2001 Budget, the Government introduced a number of measures to encourage innovation in business. These included extension of a number of initiatives aimed specifically at SMEs (for example, extension of both the Enterprise Management Incentives and All-Employee Share Ownership scheme).[116] It also announced consultation on proposals to extend the R&D tax credits currently available to SMEs to large firms, as we recommended in 2000.[117] **We welcome the fiscal measures introduced in the Budget to encourage research and development and recommend that uptake be**

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107 For an explanation of LINK and the Teaching Company Scheme, see paragraph 41.
108 Evidence, p 92, paragraph 11; p 115, paragraph 5; p 192, paragraph 5.
109 Evidence, p 142.
110 Evidence, p 137, paragraph 9.
111 Cm 4814, chapter 1, paragraph 35.
112 HC 195-I, paragraph 22.
113 Evidence, p 132-133, paragraph 7; p 172, paragraph 44.
114 *SET Statistics 2000*, Table 7.1.
115 HC 274-i, Q 16.
116 *Budget 2001*, HC 279, p 42, paragraph 3.27, and p 43, paragraph 3.29.
117 HC 195-I, paragraph 60. See too HC 274-i, Qq 9-10, 18.

carefully monitored. Government should also conduct a proactive campaign to promote innovation among those parts of industry which are not traditionally strong in R&D.

Engaging the Public

52. *Realising Our Potential* recognised that there was a broad social and economic need to raise the general public's level of understanding and awareness of scientific and technological issues and the role of science, engineering and technology in the economy.[118] It applauded the efforts already underway, by organisations such as the Royal Institution and the British Association for the Advancement of Science, and undertook to work together with key players in the field – including the Wellcome Trust and the Gatsby Charitable Foundation – to promote a campaign throughout the country: co-sponsoring exhibitions, encouraging project work in schools, promoting careers opportunities and working to improve scientists' understanding of communicating with the public.[119]

53. *Realising Our Potential* gave government support and added credibility to the activities already being undertaken to promote science to the public, and authorised real expenditure on these activities from the science budget.[120] Some of these activities – Science Week, for example – have had enduring success; but overall this has been one of the least successful aspects of the 1993 White Paper.[121] Issues such as the BSE crisis and rapid developments in areas such as biotechnology, which were leading to public unease, have had far greater an impact on the public perception of science and science advice. In our recent Report on the Scientific Advisory System, we highlighted the loss of public confidence in scientific advice to Government.[122] The 2000 Report of the House of Lords Committee on Science and Technology on Science and Society examined in depth public attitudes to, and understanding of, science.[123] The evidence we have received in this inquiry supports the view that **there needs to be better dialogue between scientists and the public.**[124]

54. *Excellence and Opportunity* acknowledges the need for effective dialogue with the public, and outlines a number of new initiatives. The OST, with the Wellcome Trust, is conducting a review of scientific communication. The Government undertakes to work with the Royal Society, Research Councils, Science Centres and others to ensure that they operate as centres of dialogue and debate, as well as of information. And 2001/02 has been designated "Science Year".[125]

55. *Realising Our Potential* did not consider it sensible to attempt any central direction of the diverse activities in the public understanding of science.[126] *Excellence and Opportunity* has taken a similar approach, introducing new activities but not outlining a clear strategy. In the evidence we have received, public understanding of science activities are criticised for being generally too small or inadequately co-ordinated or characterised by "professional amateurism".[127] Learned Societies felt that their activities in this area had been overlooked and that they should be involved to a greater extent.[128] Responsibility for promotion of science is spread over a number of bodies: the Royal Society, the British Association, and the Royal Institution, for example. COPUS (the Committee on the Public Understanding of Science) was set up to co-ordinate these activities, but it has not been very effective to date. We welcome the

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[118] Cm 2250, paragraph 7.32.
[119] Cm 2250, paragraphs 7.34 - 7.37.
[120] Evidence, p 126, paragraph 8.
[121] Evidence, p 138, paragraph 21.
[122] HC 257, paragraphs 55, 59.
[123] Third Report of House of Lords Select Committee on Science and Technology, Session 1999-2000, *Science and Society*, HL Paper 38.
[124] HC 466-iv, Q 215. Evidence, p 87, paragraph 27; p 156, paragraph 21; p 170, paragraph 26.
[125] Cm 4814, chapter 1, paragraph 32, and chapter 4, paragraphs 31 - 34.
[126] Cm 2250, paragraph 7.35.
[127] Evidence, p 128, paragraph 2; p 171, paragraph 32.
[128] Evidence, p 115, paragraph 8; p 238.

steps that are currently being taken to remodel COPUS. COPUS should also be retitled.[129] "The Public Understanding of Science" is an outmoded and patronising term, suggesting ignorance on the part of the public. The imperative is not so much to improve the public's understanding but to ensure that science responds to what people want, and meets public concerns. **We welcome the increasing use of the term "Science and Society" or, even better, "Science for Society", to describe activities to promote dialogue and mutual understanding between the scientific community and the public.**

56. Government has a clear interest in supporting activities which promote science to the public, and a responsibility to ensure that they are properly funded. **We recommend that the Government work with the scientific community to build a new strategy for promoting science and technology, building upon the work already being done but reaching out to a broader range of participants and a wider audience.**

Science Teaching in Schools

57. *Realising Our Potential* recognised the critical importance to our future prosperity of high quality science education, including science teaching in schools.[130] It expressed confidence that the Government's educational system would lead to more young people having the grounding in mathematics, science and technology needed to pursue these subjects in higher education. The number of young people taking mathematics and science A levels has gone up by 18.4% since 1994, against an overall increase of 5.7%; though there has been a recent fall in some individual science subjects.[131] **We regret the move towards generalist science courses, which we fear will dilute the knowledge base and result in inadequate preparation for higher education in the sciences.**

58. **The quality of science teaching in schools has become a major concern.** In recent months we have held meetings with a number of industrial bodies. Without exception, they have highlighted science teaching in schools as one of their urgent concerns. Representatives of the management of Corus plc, for example, identified the state of physics teaching in schools in the UK, and the shortage of physics teachers, as an extremely serious concern for their company.[132] The Chemical Industries Association, on the other hand, placed particular emphasis on science teaching in primary schools, on the ground that it was at that age that children could be fired with enthusiasm for science. There is an increasingly acute shortage of well qualified science teachers, particularly in mathematics and the physical sciences; and their age profile means that the problem will become progressively worse as well qualified teachers retire.[133] As *Excellence and Opportunity* acknowledges, too many teachers do not have degrees in the science subjects they teach.[134] If science teachers are not properly trained in the subject they teach, they may find it very hard to communicate a real enthusiasm for the subject. They may also be ill-equipped to teach the practical applications of the science which are often most attractive to children. The problem is compounded by over-stringent application of Health and Safety regulations, which inhibit the conduct of practical experiments. **We note that the House of Lords Committee highlights the decline in the amount of practical work in its recent Report on Science in Schools, and recommends that continuing professional development for teachers should be specifically targeted at the problem of declining practical work.[135] We wholeheartedly endorse these views.**

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[129] See HL Paper 38, paragraph 3.18.
[130] Cm 2250, paragraph 7.1.
[131] Cm 4814, Chapter 2, paragraph 6, and Table 1. These figures show the percentage increase from 1994/95 to 1998/99 in A level achievement of 17 year old candidates in schools and FE colleges in England.
[132] Second Report, Session 2000-01, *Corus plc – Research and Development*, HC 110, Qq 16, 40; and paragraph 16.
[133] See Chapman, Steven: *The State of the Physics Teaching Population*, to be published in *Science Teacher Education*, May 2001.
[134] Cm 4814, Chapter 2, paragraph 11.
[135] First Report of the House of Lords Select Committee on Science and Technology, Session 2000-01, *Science in Schools*, HL Paper 49, paragraphs 37-42.

59. The Government has introduced a number of welcome measures to improve science teaching in schools. £60 million has been provided to upgrade science laboratories in schools.[136] Some curriculum changes have been introduced, though there remains a widespread view that the national curriculum inhibits imaginative science teaching. Perhaps most importantly, the Government is trying to tackle the shortage of science teachers by recently introducing a £10,000 training and recruitment package for teachers in specialist subjects. We note that the Education and Employment Committee has recommended that consideration should be given to paying higher than ordinary salaries to teachers in shortage subjects, including science.[137] We support this proposal, though, whatever the premia, teaching salaries are unlikely to compete with those paid in industry. **How to attract high quality science and technology graduates into teaching is a real problem, to which there is no ready answer. Nevertheless, it is a matter which has to be addressed as a matter of urgency.** Given the importance to industry of ensuring good quality S&T teaching in schools, we would argue that industry could reasonably be expected to contribute, perhaps by allowing day-release or sabbatical release of staff for teaching in schools, though they would have to be appropriately trained. There is also scope for encouraging post-doctoral research scientists into teaching.

60. Steps have been taken to improve the professional development of science teachers, by increasing contact between teachers and scientists in Higher Education and in industry. The Council for Science and Technology reported on this in February 2000.[138] The recent Report from the House of Lords Committee on Science in Schools also focuses on the Continuing Professional Development of teachers.[139] There are a number of new schemes to link school pupils, too, with scientists in industry and universities. *Excellence and Opportunity* announced a new Science Ambassadors programme to link top science students with their old schools and colleges; and the Young Foresight programme – modelled on the work of the Foresight Panels – is challenging young people in around 100 schools, with the aid of mentors from business, to identify and solve problems associated with the development of innovative new products for the year 2020. We welcome these initiatives and commend those companies which are contributing to them. However, schemes such as these, valuable as they are, reach only a small minority of children. **It is essential that the Government develop a clear strategy for improving the quality of science teaching in all schools, providing for both teachers and students to gain experience of science and technology in "the real world".**

The Quality of Science, Engineering and Technology Graduates

61. In our Report on Engineering and Physical Sciences Based Innovation, published in February 2000, we reported the problems experienced by many companies in meeting their requirement for science graduates.[140] The problem was not so much the quantity of science graduates but the number of high quality graduates available. There is reported to be a serious decline in the practical competence of SET graduates. We called on the Government to recognise the need to increase the quality and levels of competence of SET graduates.[141] We reaffirmed that conclusion in our Report on Government Research on R&D.[142] Some companies are having to recruit graduates from abroad.

62. *Realising Our Potential* raised some concerns about the nature of PhD training, suggesting that it did not always match up to the needs of a career outside research in academia or an industrial research laboratory.[143] It endorsed the view of the Royal Society that PhD training

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[136] Cm 4814, Chapter 2, paragraph 14.
[137] Sixth Report of the Education and Employment Committee, *The Professional Status, Recruitment and Training of Teachers,* Session 1996-97, HC 131, paragraph 76.
[138] *Science Teachers: A report on supporting and developing the profession of science teaching in primary and secondary schools,* CST, February 2000.
[139] HL Paper 49.
[140] HC 195-I, paragraphs 88-89. See also *Projections of Occupations and Qualifications, 2000.* Available at www.skillsbase.dfee.gov.uk.
[141] HC 195-I, paragraph 89.
[142] HC 196-I, paragraph 55.
[143] Cm 2250, paragraphs 7.14-7.25.

should be modified to include some non science-specific training, including communication and management skills. And it called on the research and funding councils to develop plans to change the balance of support in favour of more Master's level training.

63. *Realising Our Potential* proposed the development of a new post-graduate degree – the MRes. This degree was intended to provide graduates with an opportunity to gain further experience within their discipline, particularly in the laboratory, or to broaden their knowledge base. They would also be given training in the core skills – numeracy, literacy, communications skills – and gain some understanding of business processes. The Research Councils funded a number of pilot courses for a period of five years in selected university departments. In many case these MRes courses have been successful and the experience and qualification valued by the students in determining the direction of their future careers. A review of the MRes was undertaken by the Research Councils and they have continued to provide funding for these courses. It is as yet too early to gain any estimate of the value of this degree to employers.

The PhD Stipend

64. In July 2000, the Government announced a very significant increase in the PhD stipend.[144] The minimum stipend for students outside London will increase, by 2003-4, from £6,620 to £9,000 a year. (The increase will be gradual, rising to £6,800 in 2000-01, £7,500 in 2001/02 and £9,000 by academic year 2003/4.[145]) This is a 23% increase in real terms, and will cost £20 million per year by 2003-4 if student numbers remain the same.

65. This is a change to the *minimum* student stipend. Research Councils are free to increase the stipend if they consider it necessary. In the current year, the MRC pays £7,900 on average, the BBSRC £7,380 (or £15,460 for veterinary graduates) and EPSRC, ESRC, NERC, and PPARC all pay £6,800.[146] Medical charities generally pay significantly higher stipends to research students. The Wellcome Trust, for example, pays its research students approximately the equivalent to a Research Council postdoctoral research assistant starting salary. Industry too provides for enhanced stipends in studentship schemes they support, such as CASE. **The inconsistency in the PhD stipend paid by different Research Councils and by independent agencies is unfair and is likely to be distorting, given the current levels of post-doctoral research salaries.**

66. £9,000, though tax free, is still not a very attractive salary, when compared to the initial salaries offered to young graduates in industry, or even within the public sector. *Excellence and Opportunity* stated that the Government's aim was not to compete with starting salaries in business, but to provide a better basis for students to pursue their studies.[147] Lord Sainsbury told us that he "would not want to defend this as being princely earnings for people to do this kind of research", and that he would personally like to pay more, but that there were other priorities for funds, notably the position of junior researchers.[148] Mr Byers, too, accepted that "we need to get to a situation where we are providing adequate rewards".[149] **We welcome the very significant increase in the minimum PhD student stipend, but we believe that it is still not enough to ensure that the best graduates stay on to do doctoral research. The Government should work towards a further significant increase in the PhD student stipend.**

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144 Treasury Press Notice, 85/00, 5 July 2000.
145 The numbers for students in London are slightly greater.
146 Standard awards outside London.
147 Cm 4814, Chapter 2, paragraph 33.
148 HC 898-i, Q 56.
149 HC 274-i, Q 24.

Career Paths for Scientists

67. **While the increase to the PhD stipend is welcome, a more serious problem lies with the pay and conditions for post-doctoral scientists.** Many of our witnesses have highlighted this problem.[150] Pay is very low. For example, post-doctoral research staff at Imperial College are currently paid less than office receptionists in Central London. More damaging still is the fact that many scientists are perpetually on short-term contracts. This insecurity is bad for morale, and it also creates mortgage difficulties and may affect pension entitlement. Not surprisingly, many people opt for more secure, and better paid, jobs in industry and commerce, or go abroad, leading to recruitment and retention problems in the UK science base. We note that the Education and Employment Committee has highlighted the casualisation of higher education staff contracts in its recent Report on student retention, and has recommended that the Higher Education Funding Council for England should investigate the reasons why higher education institutions are employing more part-time and fixed-term staff.[151] We share the Committee's concern. The 1999 Bett Report (the independent review of Higher Education pay and conditions) emphasised the risk of significant recruitment and retention problems in the "not too distant future" and called for extra investment by Government to fund pay increases.[152] *Excellence and Opportunity* acknowledged that the career development prospects for young researchers were a cause for concern; and stated that the Government was encouraging the universities and the Funding and Research Councils to promote good practice in career development.[153] This is welcome, but not enough. **The Government can no longer afford to ignore the problem of low pay and poor job security for post-doctoral researchers and support staff. A shortage of skilled personnel threatens to undermine its commitment to strengthening the science base.**

68. We are also concerned that scientists who do succeed in securing a permanent position, perhaps as a lecturer, are often diverted away from research into broader teaching and administrative duties. We do not wish to divorce research from teaching. The very best scientists can often be brilliant at both teaching and research. But others, though excellent in research, are poor in communicating their learning to students; and some are inspired teachers while unproductive in research. **What is important is to build on the strengths of the individual and to accord equal value, and rewards, to both teaching and research.**

69. We are aware that the Royal Society supports some research professorships, which have no teaching commitments. There may be a case too for creating career research posts for younger scientists and engineers who demonstrate particular promise in research. We are encouraged by Mr Byers's willingness to consider the possibility of funding such posts.[154] We must identify promising researchers and fund them properly. Funding should not be limited to projects, but should be available for speculative, pre-project, exploratory research. Fellowships should be available to support, and encourage, excellent researchers through the difficult early years of their careers. We note that Sir Gareth Roberts, President of Wolfson College Oxford, has been asked to conduct an independent review of the supply of skilled scientists and engineers in the UK, reporting by February 2002.[155] We welcome this review, and hope that it will address the need to provide a proper career path for young scientists and engineers. **We must do more to support excellent scientists and engineers.**

70. *Excellence and Opportunity* states the Government's commitment to encouraging more scientists and engineers to come to the UK, to study and then to stay on to work.[156] We welcome the measures taken to remove barriers imposed by immigration and work permit rules. We also need to attract people who have gone to work abroad back to the UK. We welcome the scheme,

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[150] Evidence, p 224, paragraph 4; p 225; p 227; p 242, paragraph 15; pp 243-244; p 236.
[151] Sixth Report of the Education and Employment Committee, Session 2000-01, *Higher Education: Student Retention*, HC 124.
[152] Independent Review of Higher Education Pay and Conditions, Report of a Committee chaired by Sir Michael Bett, May 1999, eg paragraphs 64, 352. See too HC 124, paragraphs 50, 52, 63-66.
[153] Cm 4814, Chapter 2, paragraph 34.
[154] HC 274-i, Q 27.
[155] HC 274-i, Q 17.
[156] Cm 4814, Chapter 2, paragraph 39.

announced in the recent Enterprise, Skills and Innovation White Paper, to attract experienced British entrepreneurs back from abroad.[157] The need to attract skilled managers into the country has been highlighted in recent meetings we have held with industrialists, for example by the BioIndustry Association. **The Government must ensure that schemes to encourage experienced entrepreneurs from abroad to come to the UK are not undermined by tax disincentives.**

Women in Science, Engineering and Technology

71. *Realising Our Potential* emphasised the urgent need to attract more women into science and engineering.[158] In March 1993, the Chancellor of the Duchy of Lancaster established a Committee on Women in SET, under the overall chairmanship of the Chief Scientific Adviser, to advise on ways in which the potential, skills and expertise of women could best be secured for SET. The report of the Committee, and its Working Group, *The Rising Tide*, was published in 1994.[159] Sir Robert May told us that most of the 14 recommendations made in *The Rising Tide* had been implemented. The representation of women on SET advisory bodies had increased to 25% a year before target, for example. In two significant respects, however, Sir Robert May acknowledged that they had failed: the Treasury had not been persuaded to allow childcare costs to be claimable against income tax; and the post-16 curriculum had not been broadened to encourage young people, and girls in particular, to carry on with science.[160]

72. The OST considers that "significant progress" has been made in this area.[161] A special unit has been set up in the OST to co-ordinate activity. Through the Athena project, the OST is working with other bodies to encourage women to take up SET in Higher Education. There is an encouraging increase in the number of girls studying science to A level and in the number of women science graduates.[162] Yet, women remain under-represented within the SET community, particularly in the mathematically-based sciences and engineering. And women who are working in SET appear to be less successful than their male colleagues. The proportion of grant applications from women academics, for example, is significantly lower than the proportion of women in each discipline; though there is no evidence of bias in the grant application process.[163] Few women reach the top positions: *Excellence and Opportunity* points out that fewer than 10% of biological sciences professors are women, though women are now over 60% of graduates in the biosciences.[164]

73. *Excellence and Opportunity* acknowledged that we need to do more to help women to progress in scientific careers, and to help those who leave scientific careers, perhaps to have a family, to return.[165] It announced that the Government was carrying out a study to identify the barriers faced by women returners and to evaluate ways of overcoming these barriers; and that in 2001 it would act on the results of this study. It also extended the target of women on SET-related bodies to 40% by 2005. This is welcome, though achievement of this target will necessarily add to the many demands on the relatively few women in senior positions in SET.

74. **We welcome the Government's commitment to improving opportunities for women in science, engineering and technology.** It is essential that we should be encouraging girls to take up science at school – physical sciences as well as life sciences – and to continue with it post-16, and into higher education. We must ensure that women scientists and engineers have equal job opportunities (for example, by requiring that there be at least one woman on every interview panel) and we must offer proper career pathways to women, with better arrangements

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157 Cm 5052, paragraph 6.13.
158 Cm 2250, paragraph 7.13.
159 *The Rising Tide*, HMSO, 1994.
160 HC 466-iv, Q 217.
161 HC 466-iv, OST p 38, paragraph 1.4.
162 Cm 4814, p 13, table 2.
163 HC 466-iv, Q 218. See report '*Who Applies for Research Funding?*', National Centre for Social Research, 2000.
164 Cm 4814, Chapter 2, paragraph 35.
165 Cm 4814, Chapter 2, paragraphs 36-38.

for women returners. **It is clear that there are still barriers to women realising their potential in science, engineering and technology.**

Location of the Office of Science and Technology

75. The OST was established within the Cabinet Office in 1992. It was moved to the Department of Trade and Industry in 1995. Lord Waldegrave regarded the move as "a serious mistake" and argued that the OST should be put back "at the centre" with a Minister in Cabinet.[166] Other witnesses have suggested that the DGRC should remain with the DTI but that the Chief Scientific Adviser should be in an independent location, perhaps the Cabinet Office.[167] In our 2000 Report on Government Expenditure on R&D we considered whether there was a case for moving the OST out of the DTI. We concluded that it should remain within the DTI, though we recommended that the Minister for Science should be raised to Cabinet rank.[168] We see no reason to change this view. The OST's separation from the Department of Education risked distancing science policy from higher education policy and from management of the Universities; but in practice this seems to have caused little difficulty. Locating the OST within the DTI almost certainly increases the emphasis which is put on SET's role in wealth creation, perhaps at the expense of its role in furthering human knowledge and the quality of life; but it has led to a significant increase in funding. In practice, the OST's move to the DTI seems to have worked well. **We stand by our view that the Office of Science and Technology should remain with the Department of Trade and Industry, and that the Minister for Science should be raised to Cabinet rank.**

Research and Development in Government Departments

76. While the significant increase in the science budget has been widely welcomed, there remains concern that the increase in Research Council spending is being parallelled by a reduction in departmental expenditure on R&D. In our 2000 Report on Government Expenditure on R&D, we examined this question in detail. We reported that "the suspicion persists that the increased Science Budget is being asked to bear the brunt of cuts in departmental allocations" and called on the Government, in the 2000 Spending Review, to halt and reverse the long-term decline in civil departments' R&D spending.[169] Mr Byers assured us the Spending Review had stopped this decline, and that a number of major departments would increase their spending on R&D over the next three years.[170] **We hope that the departmental science strategies, which are expected to be published in the Summer of 2001, will demonstrate that departments are committing additional funding to research and development. The publication of Forward Look 2001 also provides an opportunity for Government to show the impact of the 2000 Spending Review on overall government expenditure on R&D.**

Scientific Expertise in Government

77. There is also continuing concern about the reduction in the number of scientific staff in Government Departments. Figures supplied in evidence from the Institution of Professionals, Managers and Specialists (IPMS) show that personnel engaged in R&D in UK Government civil departments decreased by 24.2%, from 8.232 to 6,237, in the ten years from 1988 to 1998.[171] We have underlined our concern about this loss of expertise on several occasions before – most recently in our Report on the Scientific Advisory System.[172] The current foot and mouth crisis demonstrates all to clearly how important it is for Departments to have scientific expertise in-house. Access to external scientific advice is not enough: Departments must be able to ask the

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166 HC 466-iii, Qq 119-123.
167 Evidence, p 104, paragraph 20; p 126, paragraph 7; p 172, paragraph 37.
168 HC 196-I, paragraphs 127, 131, 134.
169 HC 196-I, paragraph 32. Also paragraph 134.
170 HC 274-i, Q 9.
171 Evidence, p 273. Source: *SET Statistics 2000*, Table 8.4.
172 HC 257, paragraph 44.

right questions and interpret the advice received. And scientists within Government must have more clout: policymakers must listen to what they say. **If public confidence in science is to be restored, it is essential that Government Departments have sufficient well-qualified scientific staff in-house to advise on scientific matters and to ensure that Government is able to make full use of science and technology; and there must be mechanisms to ensure that their advice is taken into account by policymakers.**

Devolution

78. *Excellence and Opportunity* is the first Science White Paper to be published since devolution of the management of many aspects of science and innovation policy to the new administrations in Scotland, Wales and Northern Ireland. Funding of higher education in those parts of the UK is now devolved, as is support for industry and economic development, but Research Council spending across the UK remains the responsibility of UK Government. This has implications for the dual support system for higher education institutions. The White Paper makes clear that it presents a science and innovation strategy for the UK as a whole, and states that the UK Government and the devolved administrations are committed to working together.[173] The Royal Society and Royal Society of Edinburgh joint report on Devolution and Science, published in April 1999, concluded that the SET base should remain well integrated at UK level with as few internal barriers as possible.[174] **Devolution must not be allowed to weaken the UK science base. The Government must ensure that the devolved administrations are fully involved in the development of science policy in order to avoid inconsistency of purpose in the different parts of the UK.**

Measuring Success

79. The UK performs well in science. With only 1% of the world's population, the UK has, on a continuing basis carried out 5.5% of the world's research effort and has been a major force in research with an 8% share of world scientific publications and a 9.1% share of world citations. In absolute terms, this has placed the UK a clear second to the US and significantly ahead of countries such as Japan, Germany and France.[175] In terms of citations per million pounds invested the UK has been the most cost-effective producer of scientific research. The UK has also been second only to the US in winning major international science prizes. However, this data is historical (based on figures for 1981-94, produced in the OST's 1997 report, '*The Quality of the UK Science Base*') and so speaks to past performance. We believe that UK science is still excellent and cost-effective, but this needs to be demonstrated in order to provide a firm base for further investment. **We recommend that the Office of Science and Technology update its report measuring the quality of the UK Science Base on a regular basis.** With the increasing globalisation of research and increased public investment in science in a number of countries including the US and Australia, we cannot afford to rest on our laurels.[176] **Sustained and substantial funding of the science base will be required to ensure that the UK can continue to 'punch above its weight'.**

80. Worryingly, the overall UK spend on R&D since 1993, expressed as a percentage of gross domestic product, has decreased from 2.09% to 1.8%.[177] International comparisons show that the R&D spend in both the US and Japan increased (US: 1993 - 2.62%, 1998 - 2.77%. Japan:1993 - 2.68%, 1997 - 2.89%), and while the spend in France and Germany decreased (France: 1993 - 2.45%, 1998 -2.20%. Germany: 1993 - 2.42%, 1998 - 2.32%), both remained higher than in the UK. Expenditure for higher education R&D has remained fairly constant since 1993, with the figure, expressed as a percentage of GDP, for 1998, of 0.35%. Business

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[173] Cm 4814, Chapter 1, paragraphs 27-28.
[174] *Devolution and Science: Implications of Scottish Devolution*, A Joint Working Group of the Royal Society of London and the Royal Society of Edinburgh, April 1999. See Evidence, p 145 RSE, paragraph 14.
[175] HC 466-iv, page 44, issue 12, OST.
[176] *Nature*, Volume 409, 11 January 2001, p 123; *Nature*, Vol 410, 8 March 2001, p 134.
[177] *SET Statistics 2000*, table 7.1.

R&D expenditure has followed a consistent downward trend since 1993, but industry funding of R&D in universities over the 1993 to 1998 period increased from £130 million to £207 million.[178] This apart, **we are yet to see hard evidence that the policies introduced by *Realising Our Potential* have had a significant impact on investment in science and innovation.**

Conclusion

81. The policies introduced by *Realising Our Potential* and enhanced by *Excellence and Opportunity* have been widely welcomed. It is generally held that there has been a culture change in UK science, drawing scientists closer to industry. There appears to have been less of a culture change in industry, which – outside a few key sectors – is still slow to innovate. R&D expenditure by industry is still far too low in comparison to our competitors. The significant increase in the Science Budget in the 1997 and 2000 Spending Reviews have been widely applauded; though there is concern that the gain is to some extent offset by the decline in Departmental spending on R&D. There is no doubt that achievement of the two White Papers' aims will depend on the Government sustaining the increase in the Science Budget and increasing it still further over the longer term. It is because Government – and the Treasury in particular – appreciates that science is vital to our prosperity that science has done well in the two Spending Reviews. Yet there is some concern that the emphasis on wealth creation may have gone too far, leading us to neglect science's role in promoting quality of life and in the pure pursuit of knowledge. There are also real worries about the UK's ability to provide the qualified scientific personnel needed in the new knowledge economy. Action is urgently required to address the shortage of good science teachers in schools and to provide proper career development for research scientists, including women returners. It is clear that the UK has not yet realised its full potential.

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[178] HC 466-iv, p 40, issue 4.

LIST OF ABBREVIATIONS USED IN THE REPORT

ABRC ..... Advisory Board of the Research Councils

ACOST ..... Advisory Council on Science and Technology

BBSRC ..... Biotechnology and Biological Sciences Research Council

BSE ..... Bovine Spongiform Encephalopathy

CASE ..... Co-operative Awards in Science and Engineering

CCLRC ..... Council for the Central Laboratory of the Research Councils

COPUS ..... Committee on the Public Understanding of Science

CST ..... Council for Science and Technology

DETR ..... Department of the Environment, Transport and the Regions

DfEE ..... Department for Education and Employment

DGRC ..... Director General of the Research Councils

DTI ..... Department of Trade and Industry

EPSRC ..... Engineering and Physical Sciences Research Council

ESRC ..... Economic and Social Research Council

GDP ..... Gross Domestic Product

HEROBC ..... Higher Education Reach Out to Business and the Community (Fund)

IP(R) ..... Intellectual Property (Rights)

IPMS ..... Institution of Professionals, Managers and Specialists

MRC ..... Medical Research Council

MRes ..... Research Master's (course)

NERC ..... Natural Environment Research Council

OST ..... Office of Science and Technology

PPARC ..... Particle Physics and Astronomy Research Council

R&D ..... Research and Development

S&T ..... Science and Technology

SET ..... Science, Engineering and Technology

SMART ..... Small firms Merit Award for Research and Technology

SME ..... Small and Medium-sized Enterprise

PROCEEDINGS OF THE COMMITTEE RELATING TO THE REPORT

WEDNESDAY 28 MARCH 2001

Members present:

Dr Michael Clark, in the Chair

Dr Brian Iddon
Dr Lynne Jones
Dr Ashok Kumar
Mr Tony McWalter
Dr Desmond Turner

The Committee deliberated.

Draft Report (Are We Realising Our Potential?), proposed by the Chairman, brought up and read the first time.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 81 read and agreed to.

Resolved, That the Report be the Sixth Report of the Committee to the House.

Ordered, That the Chairman do make the Report to the House.

Several papers were ordered to be appended to the Minutes of Evidence.

Ordered, That the Appendices to the Minutes of Evidence taken before the Committee be reported to the House.—(*The Chairman.*)

Several papers were ordered to be reported to the House.

[Adjourned till Monday 2 April at half past Four o'clock.

LIST OF WITNESSES

Wednesday 10 May 2000

Wednesday 14 June 2000

THE COMMITTEE OF VICE CHANCELLORS AND PRINCIPALS

Monday 19 June

Monday 26 June 2000

Monday 3 July 2000

BRITISH TELECOMMUNICATIONS PLC

IMPERIAL CHEMICAL INDUSTRIES GROUP PLC

ROLLS-ROYCE PLC

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LIST OF APPENDICES TO THE MINUTES OF EVIDENCE VOLUME II

Memoranda from: *Page*

UNPRINTED MEMORANDA

Additional Memoranda have been received from the following and have been reported to the House, but to save printing costs they have not been printed and copies have been placed in the House of Commons Library where they may be inspected by Members. Other copies are in the Record Office, House of Lords, and are available to the public for inspection. Requests for inspection should be addressed to the Record Office, House of Lords, London, SW1 (Tel 020 7219 3074). Hours of inspection are from 9.30 am to 5.30 pm on Mondays to Fridays.

1. Annex to Memorandum submitted by the Save British Science Society
2. Appendices to Memorandum submitted by the Particle Physics and Astronomy Research Council
3. Appendices to Memorandum submitted by Rolls-Royce plc
4. Appendices to Memorandum submitted by the Association of the British Pharmaceutical Industry
5. Appendix to Memorandum submitted by Professor D H Saxon, University of Glasgow
6. Annex to Memorandum submitted by the Royal College of Veterinary Surgeons
7. Annex to Memorandum submitted by the Association of Veterinary Teachers and Research Workers

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Second Report: The Year 2000—Computer Compliance (HC 342)

Third Report: Glaxo Wellcome and SmithKline Beecham: The Merger Proposals (HC 627)

Fourth Report: The Cloning of Animals from Adult Cells (HC 1039)

Fifth Report: British Biotech (HC 888)

Sixth Report: Science and the Comprehensive Spending Review (HC 1040)

First Special Report: The Government's Response to the Committee's Fourth Report, Session 1996–97, The Research Council System: Issues for the Future (HC 302)

Second Special Report: The Government's Response to the Committee's Third Report, Session 1996–97, The Natural Environment Research Council and Research into Climate Change (HC 306)

Third Special Report: The Government's Response to the Committee's First Report, Session 1997–98, The Implications of the Dearing Report for the Structure and Funding of University Research (HC 799)

Fourth Special Report: The Government's Response to the Committee's Fifth Report, Session 1997–98, British Biotech (HC 1185)

Session 1998–99

First Report: The Scientific Advisory System: Genetically Modified Foods (HC 286)

Second Report: The National Endowment for Science, Technology and the Arts (HC 472)

Third Report: The Scientific Advisory System: Mobile Phones and Health (HC 489)

Fourth Report: The Regulation of the Biotechnology Industry (HC 535)

First Special Report: The Government's Response to the Committee's Sixth Report, Session 1997–98, Science and the Comprehensive Spending Review (HC 234)

Second Special Report: The Government's Response to the Committee's Second Report, The National Endowment for Science, Technology and the Arts (HC 822)

Session 1999–2000

First Report: The Year 2000—Computer Compliance: Follow-Up (HC 37)

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Third Report: Scientific Advisory System: Diabetes and Driving Licences (HC 206-I)

Fourth Report: Glaxo Wellcome and SmithKline Beecham (HC 207-I)

Fifth Report: Government Expenditure on Research and Development: The Forward Look (HC 196-I)

Sixth Report: Cancer Research—A Fresh Look (HC 332-I)

Seventh Report: The Government's Expenditure on Research and Development: The Forward Look—The Government's Reply (HC 723)

First Special Report: Government Response to the Committee's Second Report, Engineering and Physical Sciences Based Innovation (HC 451)

Second Special Report: Joint Working with the Lords Science and Technology Committee (HC 980)

Third Special Report: Government Response to the Seventh Report of the Science and Technology Committee on the Government's Expenditure on Research and Development: The Forward Look—The Government's Reply (HC 981)

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First Special Report: The Work of the Science and Technology Committee 1997–2000 (HC 44)

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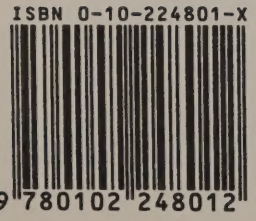

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